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Research Article

THE RELATIONSHIP BETWEEN IQ AND LEARNING MOTIVATION THROUGH EXPONENTIAL PROBLEM-SOLVING ABILITIES

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Abstract
This research aims to determine the relationship between IQ and learning motivation through problem-solving skills in exponential material. The main issue studied is how intellectual intelligence (IQ) relates to students' learning motivation through problem-solving skills. This study uses a quantitative and qualitative approach with SEM-PLS data analysis techniques. The population consists of 10th-grade students at SMK 1 Diponegoro, selected through probability sampling. Data were collected through tests, questionnaires, and documentation. The results show that IQ is related to learning motivation with a t-statistic value of 2.536 (positive). IQ is also related to problem-solving skills with a t-statistic value of 2.051 (positive). And IQ is related to learning motivation through problem-solving with a t-statistic value of 2.433 (positive). Furthermore, problem-solving ability acts as a mediating variable that strengthens the influence of IQ on learning motivation. The results of this study highlight that an increase in IQ accompanied by good problem-solving skills can optimize students learning motivation, thus indicating the importance of cognitive development and problem-solving training in education.

Keywords: Exponential, IQ, Motivation Learning, Problem Solving

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INTRODUCTION

Mathematics education plays a very important role in shaping students' logical, critical, and systematic thinking abilities. One of the topics that is considered difficult by most students is exponential material. This difficulty arises due to the abstract nature of exponential functions, which requires a strong conceptual understanding and good problem-solving skills. The low understanding of students towards exponential material impacts their learning motivation, thus necessitating learning strategies that can encourage students to be more active and motivated in their studies.

IQ as one form of intellectual intelligence, is a cognitive aspect believed to influence students' success in understanding mathematical concepts. Intellectual intelligence can be assessed through three main indicators: figural ability, verbal ability, and numerical ability (Gultom, 2020). These three indicators are closely linked to the thinking processes of students when solving mathematical problems. The higher the level of a student's intellectual intelligence, the greater the likelihood that the student has good learning motivation. However, the relationship between IQ and learning motivation is not always direct; it can be mediated by problem-solving skills.

Problem-solving skills play an important role in the mathematics learning process. Problem-solving includes four stages: understanding the problem, devising a plan, carrying out the plan, and reviewing the results (Polya, 2018). Students who are skilled in these four stages tend to be more confident in their learning, thus their motivation to continue practicing and understanding concepts increases. Therefore, problem-solving skills can serve as an important link between intellectual intelligence (IQ) and students' learning motivation.

The urgency of this research lies in the need to find strategies that can enhance students' motivation to learn mathematics through the optimization of their cognitive abilities. There are five indicators of learning motivation that need to be developed, including perseverance in learning, resilience in facing difficulties, drive and needs in learning, future aspirations, and appreciation of achievements (Uno, 2014). However, previous research that specifically links IQ, problem-solving abilities, and learning motivation in the context of exponential material is still limited. Therefore, this research is important to contribute new insights into the development of mathematics education.

Based on this background, this research focuses on analyzing the relationship between IQ and learning motivation through problem-solving ability in exponential material. The aim of this study is to determine the extent to which IQ is related to students' learning motivation, both directly and indirectly, with problem-solving ability as a mediating variable. The results of this research are expected to provide theoretical benefits in the development of mathematical education science, as well as practical benefits for teachers in designing more effective learning strategies. Thus, this research can serve as a foundation for improving the quality of mathematics learning, particularly in exponential material.

RESEARCH METHOD

This research uses a quantitative and qualitative approach with a correlational type to determine the relationship between IQ and learning motivation through problem-solving abilities. The sample used in this study is students from SMK 1 Diponegoro, selected using a probability technique.

Data were collected using three instruments, namely: a test for problem-solving, an IQ questionnaire, and a learning motivation questionnaire. The problem-solving test was structured in the form of descriptive questions related to exponential material, and was organized according to the steps proposed by Hasna et al. (2022) based on Polya (understanding the problem, outlining a plan, executing the plan, and reviewing). The IQ questionnaire was developed based on suggestions made by Gultom (2020), which has three indicators: figurative ability, numerical ability, and verbal ability. Meanwhile, the motivation questionnaire was structured based on five indicators: the desire for success, the presence of encouragement and need to learn, having hopes and aspirations for the future, appreciation for learning, and engaging learning activities.

The data analysis process includes the validity test of indicators, reliability test of variables, and hypothesis testing. According to Siskawati (2024), an indicator is said to be valid based on the SEM-PLS test when its value is greater than 0.500, a variable is said to be reliable when its value is greater than 0.600, and it is said to be related when the t-statistic value is positive. The SEM-PLS model used is as follows:

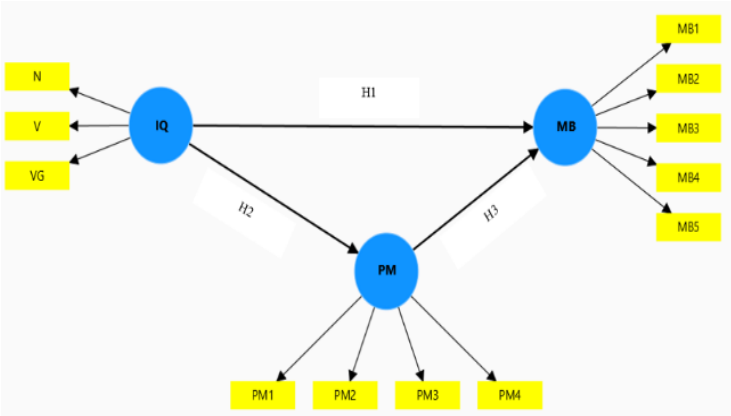

Figure 2. SEM-PLS Model

Description:

N (numeric) = indicator 1 of IQ

V (verbal) = indicator 2 of IQ

VG (figurative) = indicator 3 of IQ

PM1 (understanding the problem) = indicator 1 of problem-solving

PM2 (writing the plan) = indicator 2 of problem-solving

PM3 (executing the plan) = indicator 3 of problem-solving

PM4 (rechecking) = indicator 4 of problem-solving

MB1 (there is a desire for success) = indicator 1 of learning motivation

MB2 (there is a drive and need in learning) = indicator 2 of learning motivation

MB3 (having hopes and dreams for the future) = indicator 3 of learning motivation

MB4 (there is appreciation for learning) = indicator 4 of learning motivation

MB5 (there are interesting learning activities) = indicator 5 of learning motivation

$H_0 1$ = IQ has not relationship with learning motivation

$H_0 2$ = IQ has not relationship with problem-solving

$H_0 3$ = IQ has not relationship with learning motivation through problem-solving

$H_1 1$ = IQ has relationship with learning motivation

$H_1 2$ = IQ has relationship with problem-solving

$H_1 3$ = IQ has relationship with learning motivation through problem-solving

RESULTS AND DISCUSSION

RESULTS

The following is a model image of validity and reliability obtained through the SEM-PLS application, as shown in figure 2.

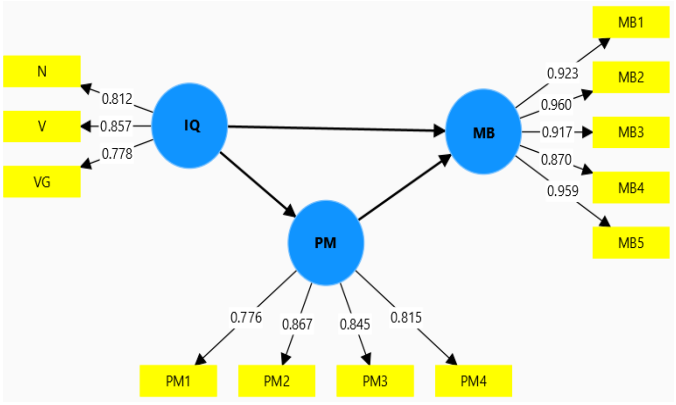

Figure 2. Validity and Reliability of Indicators

Based on the model diagram, the following table presents an easy observation of the validity of each indicator, as listed in table 1.

Table 1. Validity and Reliability Table of indicators

Indicators	Outer Loading	Validity Criteria	Composite Reability	Reabilyty Criteria
	IQ		0,857	Realibel
N	0,812	Valid		
V	0,857	Valid		
VG	0,778	Valid		
	Learning Motivation		0,968	Reliabel
MB1	0,923	Valid		
MB2	0,960	Valid		
MB3	0,917	Valid		
MB4	0,870	Valid		

MB5	0,959	Valid		
	Problem Solving		0,986	Reliabel
PM1	0,776	Valid		
PM2	0,867	Valid		
PM3	0,845	Valid		
PM4	0,815	Valid		

The Relationship Between IQ and Learning Motivation

In SEM-PLS, a variable is said to have a significant relationship if the resulting t-statistic is positive. Below is a model diagram that shows the effect of IQ on learning motivation based on its t-statistic value, presented in figure 3.

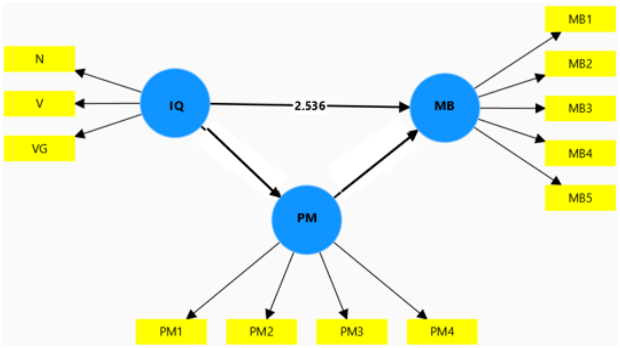

Figure 3 Results of t-statistic IQ against MB

Based on image 3, it can be seen that the obtained t-statistic value is 2.536, which is a positive value. Therefore, it can be said that IQ has a relationship with learning motivation, in other words, $H_1 1$ is accepted.

The Relationship Between IQ and Problem Solving

Similarly to the previous discussion on identifying the effect of one variable on another in the SEM-PLS application using positive t-statistic values, the following is a model diagram that shows the relationship of IQ to problem-solving based on its t-statistic value, which is presented in figure 4.

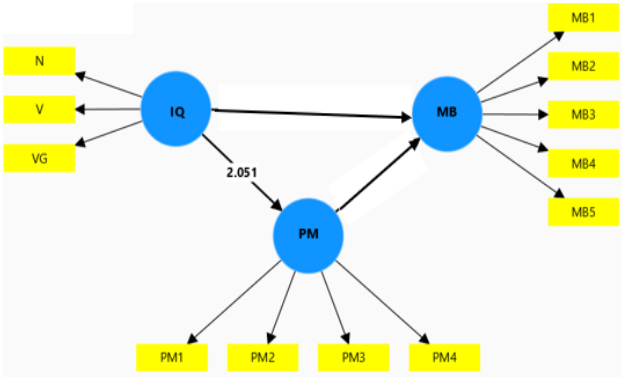

Figure 4. Results of t-statistics IQ against PM

Based on figure 4, it is seen that the obtained t-statistic value is 2.051, which is a positive value. Thus, it can be said that IQ has a significant relationship with problem-solving, in other words, $H_1 2$ is accepted.

The Relationship of IQ to Learning Motivation Through Problem Solving

Just like the previous discussion, to identify the influence of a variable on another variable in the SEM-PLS application using the positive t-statistic value. The following presents a model diagram that shows the relationship of IQ to learning motivation through problem-solving based on its t-statistic value, which is shown in figure 5.

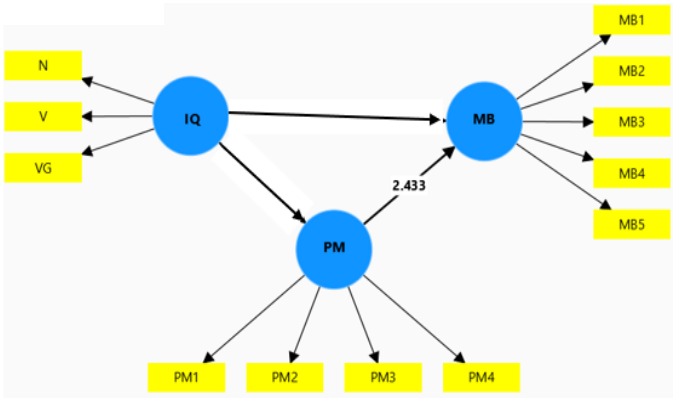

Figure 5. Results of the t-statistic IQ against MB through PM

Based on the figure, the obtained t-statistic value is 2.433. Therefore, with a positive t-statistic value, $H_0 3$, which states that IQ does not have a significant relationship with learning motivation through problem-solving, can be rejected. In contrast, $H_1 3$, which states that IQ has a significant relationship with learning motivation through problem-solving, is accepted. If presented in a figure.

DISCUSSION

The image 2 shows that all indicators meet the validity criteria, with outer loading values above 0.500. For the IQ variable, which consists of indicators N (numerical), V (verbal), and VG (figurative), the respective values obtained are 0.812; 0.857; and 0.778, indicating that all three indicators are valid. Similarly, for the MB (learning motivation) variable, which includes indicators MB1 (desire for success) to MB5 (engaging learning activities), all indicators also have outer loading values above 0.500, with a range between 0.870 to 0.960. This indicates that each indicator in the MB variable has met the validity criteria. Furthermore, the indicators in the PM (problem-solving) variable, consisting of PM1 (understanding the problem) to PM4 (double-checking), have outer loading values ranging from 0.776 to 0.867, thus stating that all indicators in the PM variable are also valid. Thus, it can be concluded that all indicators on each variable have met the established validity criteria. After passing the validity test, the next step is to conduct a reliability test to ensure that the indicators used provide consistent results. According to Siskawati et al. (2024), it is considered reliable if the composite reliability value is above 0.600. Based on the results of the reliability test shown in Table 1, all variables show composite reliability values above 0.600. For the IQ variable, a value of 0.857 was obtained, for the MB variable a value of 0.968, and for the PM variable a value of 0.896. This indicates that all these variables meet the reliability criteria and can be considered reliable. Therefore, based on the validity and reliability tests conducted, it can be concluded that all the indicators used are valid and reliable.

According to Siskawati et al. (2024), it is stated that there is a significant relationship if the t-statistic value is positive. Based on the research results presented in figure 4, the t-statistic value that reflects the relationship between IQ and learning motivation is 2.536. Therefore, it can be statistically concluded that IQ has a significant relationship with learning motivation.

The results of this study are supported by relevant research according to Samsilayurni et al. (2021), which states that there is a significant influence of intellectual intelligence and adversity. According to Mandang (2023), there is a clear and significant relationship between IQ levels and student learning motivation. Therefore, IQ plays a significant role in affecting students' learning motivation. Students with high IQs tend to understand the subject matter more easily, which makes them feel more confident and motivated to learn. This condition encourages them to be more responsible, active in the learning process, and to strive to comprehend the material as best as they can. Furthermore, IQ has a significant relationship to problem-solving with a t-statistic value of 2.051. This research is supported by relevant findings from Pasangka (2020) that state there is a significant influence of Intellectual Intelligence on the Mathematics Problem-Solving Ability of students at State Junior High Schools in Bandar Lampung and Ramli. dkk (2023) intelligence quotient (IQ) affects creative problem-solving abilities. In addition, IQ also has a significant relationship with learning motivation through problem-solving with a t-statistic value of 2.433.

CONCLUSION

Based on the analysis and discussion results that have been presented, it can be concluded that the analytical test using SEM-PLS shows significant results. This is indicated by the t-statistic value that positive on each tested pathway. First, the test results show that the relationship between IQ and learning motivation has a t-statistic value of 2.369. Second, the relationship between IQ and problem-solving has a t-statistic value of 2.040, thus it can be concluded that there is a significant relationship between IQ and problem-solving. Third, the relationship between IQ and learning motivation through problem-solving shows a t-statistic value of 2.437. Based on these results, according to the decision-making criteria, $\boldsymbol{H_0}$ is rejected and $\boldsymbol{H_1}$ is accepted. This indicates that IQ has a significant relationship with learning motivation, IQ has a significant relationship with problem-solving, and IQ has a significant relationship with learning motivation through problem-solving. The findings of this study highlight that an increase in IQ accompanied by good problem-solving skills can optimize students' learning motivation, thus demonstrating the importance of cognitive development and problem-solving training in education.

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